

Cryptosporidium: Technologies for Disinfection, Particulate Removal & By-Product Management

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Outline of Presentation

- History/Background
- Regulations
- Treatment Technologies Available
- Treatment Technologies Limitations

History

- 1945 – Texas requires disinfection
- 1974 – SDWA promulgated
- 1979 – THM Rule
- 1986 – SDWA Amendments
- 1993 – Milwaukee
Cryptosporidiosis outbreak
- 1996 – SDWA Amendments

Background

- Multiple Barrier Approach
 - Source Water
 - Treatment
 - Removal
 - Disinfection
 - Distribution

Regulations

- Microbiological Contamination
 - Giardia – 3-log removal/inactivation
 - Viruses – 4-log removal/inactivation
 - Cryptosporidium – 2-log removal
 - Turbidity – 0.3 NTU in 95% of samples

Regulations

- Disinfection and Disinfection By-Products
 - CT (disinfectant Concentration x contact Time)
 - Maximum Disinfectant Residual Level
 - Total Trihalomethanes
 - Haloacetic Acids
 - Chlorite
 - Bromate
 - Total Organic Carbon

Simultaneous Compliance

- Producing drinking water that meets all regulatory requirements
- ALL RULES ARE EQUAL
- One rule cannot be undermined in favor of another
- Simultaneous compliance will be challenge

Disinfection

- Chlorine
 - Liquid
 - Tablet
 - Gas
 - On-site generation
- Chloramine (chlorine + ammonia)
 - Liquid
 - Gas

Disinfection

- Ozone
- Chlorine dioxide
- Ultraviolet light

Limitations of Disinfectants

- Chlorine
 - Contact time
 - DBPs
 - Demand versus residual
 - Safety
- Chloramines
 - Weak disinfectant
 - Potential regrowth

Limitations of Disinfectants

- Ozone
 - Strong disinfectant
 - DBPs
 - No residual
 - Safety
 - Biodegradable organics affects water quality

Limitations of Disinfectants

- Chlorine Dioxide
 - Strong disinfectant
 - DBPs
 - No residual
 - Safety

Limitations of Disinfectants

- Ultraviolet light
 - Not a disinfectant
 - No residual
 - Special instrumentation
 - Special maintenance

Removal Technologies

- Conventional treatment
 - Flocculation
 - Sedimentation
 - Filtration
 - Monomedia
 - Dual media
 - Mixed media

Removal Technologies

- Direct filtration
- Slow sand filtration
- Diatomaceous earth filtration
- Cartridge/Bag/Backwashable filters

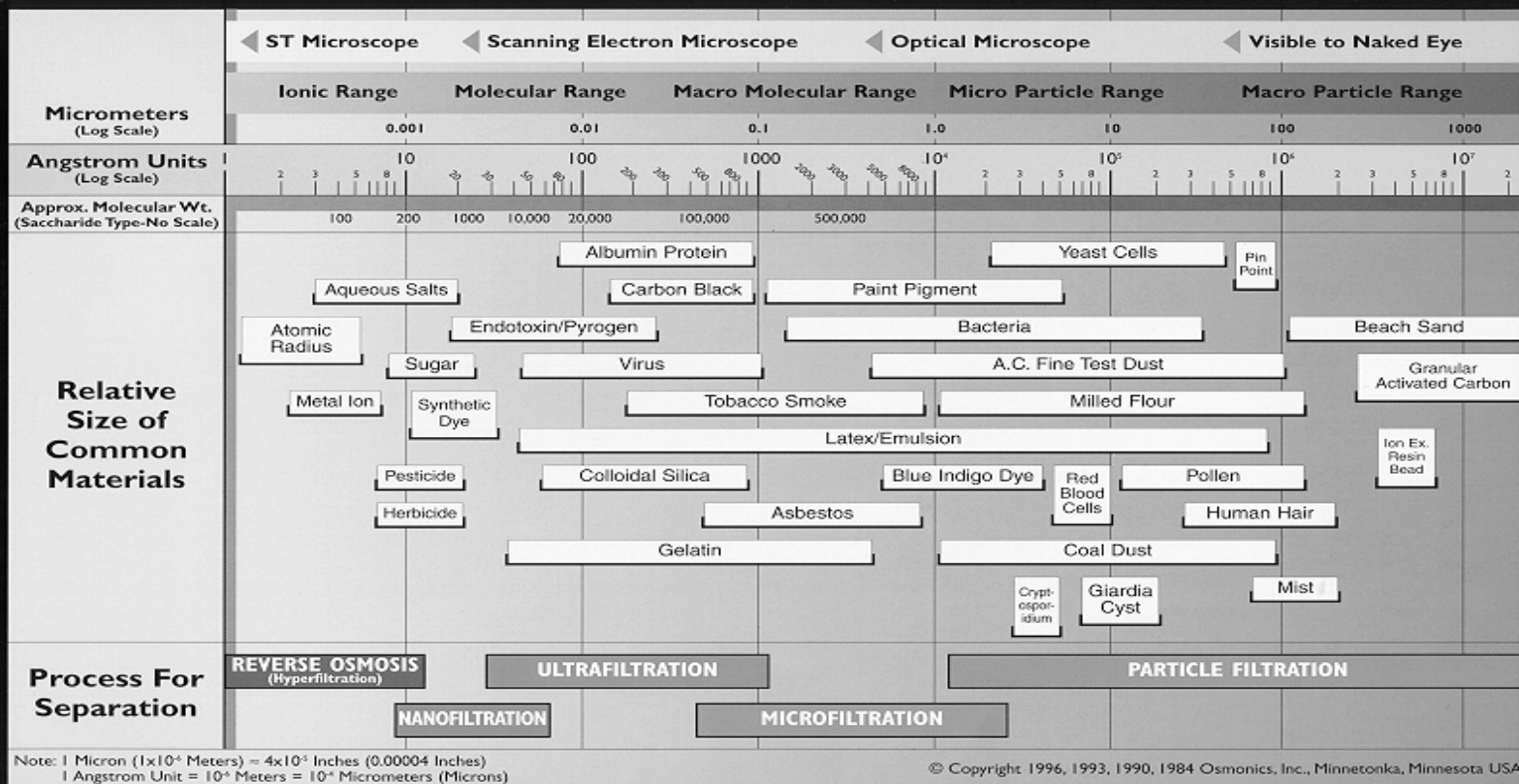
Removal Technologies

- Microfiltration
- Ultrafiltration
- Nanofiltration
- Reverse osmosis



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The Filtration Spectrum



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Removal Tech. Limitations

- Conventional treatment
 - Handle wide range of water quality
 - Expensive
- Direct filtration
 - Low turbidity
 - Algae may be a problem

Removal Tech. Limitations

- Slow sand
 - Low turbidity
 - Algae may be a problem
- Direct filtration
 - Low turbidity
 - Low removal credits for Giardia/viruses
 - Algae may be a problem
 - Not allowed in Texas on surface water

Removal Tech. Limitations

- Diatomaceous earth filtration
 - Good water quality required
 - Low bacteria and viruses removal
- Cartridge/Bag/Backwashable
 - Exceptional water quality required
 - Pretreatment required
 - Variable particulate removal

Removal Tech. Limitations

- Membranes
 - High pressure requires exceptional water quality
 - Stabilization of permeate required
 - Low pressure replaces conventional treatment
 - Cost is decreasing as usage increases

DBP Control

- Move the point of disinfectant application
- Increase DBP precursor removal
- Change the disinfectant used
 - Primary
 - Secondary

DBP Control

- Temperature
- pH
- Aggressive flushing program
- Corrosion leads to elevated disinfectant residuals
- Supplemental (boost) disinfectant addition in the distribution system



Questions & Answers